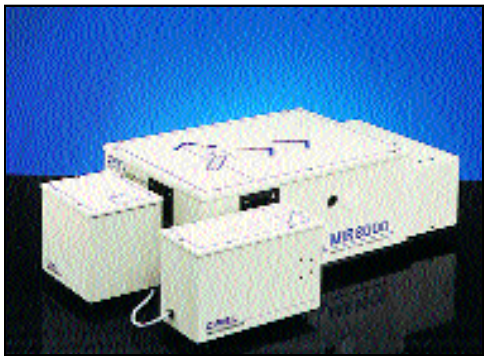
VERSATILE TUNABLE FILTER FOR OPTICAL TASKS



Radiofrequency-based technology from Ciencia helped improve a common biotech task.

Mucosal dysplasia is a precancerous condition that occurs in the gastrointestinal tract, mouth, pharynx, bladder, cervix, and lung. Cancers that originate in these areas account for a quarter million deaths per year in the United States.

BMDO HISTORY

Ciencia, Inc. (East Hartford, CT), developed acousto-optic tunable filters (AOTFs) for use in target identification and surveillance systems. In 1992, Ciencia was awarded a BMDO SBIR Phase I contract to develop a dynamically adjustable amorphous-material-based AOTF to replace birefringent crystals. Phase II funding was later awarded to pursue further development of the polymer AOTF for use in sensors. The AOTF, originally meant to capture ultraviolet radiation, has proven to be a versatile tool with a considerable impact in biomedical and biotechnology areas. For example, Ciencia is developing a prototype AOTF-based optical probe that may help to pinpoint certain types of heart disease by detecting unstable plaque in the coronary arteries.

In addition, radiofrequency generation technology developed under a BMDO SBIR for implementation of AOTFs is at the heart of the least expensive and most rapid fluorescence lifetime sensing system on the market. The system, called LifeSense™, is manufactured and distributed by Oriel Instruments (Stratford, CT).

HOW IT WORKS

Acousto-optic devices use ultrasound to alter the refractive index of an optical medium, typically a crystal. Ciencia developed an AOTF based on an organic amorphous material rather than crystals. Amorphous materials are easier and cheaper to make than crystals, allow for uniformity and quality control during manufacturing, and permit independent control of bandpass and bandwidth.

By the application of mechanical stress or electric fields, Ciencia's amorphous medium can be induced to exhibit birefringence, a type of refraction in which the speed of light through the material depends on direction as well as the light's frequency. Birefringence allows the AOTF to separate light into different colors. Unlike an ordinary monochromator, the AOTF can be tuned electronically, so it has no moving parts. In addition to being tunable, the polymeric device can produce spectrally resolved images.

MEDICAL SIGNIFICANCE

Optical Signatures. Recent studies suggest that the chemical composition of arterial plaque can indicate whether a person is likely to develop a blood clot. Ciencia's Raman-spectroscopy-based optical probe, coupled with the

AOTF, can reveal whether a plaque contains destabilizing compounds, such as collagen or oxidized low-density lipoprotein (LDL, or "bad" cholesterol), that might raise the risk of clot formation. The filters help decipher the chemical signatures picked up by the probe, which would be inserted through an ultrasound-guided catheter into the arteries of the heart.

When developed, the optical probe can help to detect patients who are poor candidates for balloon angioplasty, which carries the risk of postprocedure clot development. An even more promising application of this technology is in optical biopsy, where a fiber-optic probe can replace the scalpel to detect cancer. For sites such as the lung and gastrointestinal tract, an optical probe can be used in tandem with established endoscopic techniques to identify abnormal cells without excising them.

Fluorescence Lifetime Analyses. Oriel Instruments is using Ciencia's technology as part of LifeSense, a device that detects the fluorescence lifetime signatures of organic compounds. For less than $20,000, Oriel's LifeSense system can be used for biological and environmental research.

In molecular biology, fluorescence lifetime sensing can unlock the secrets of the human genome, as well as observe molecular diffusion in cells, antibody-mediated reactions, and a host of intra- and extracellular functions. Researchers bind special fluorescent dyes to cell structures of interest, excite the sample with an appropriate wavelength, and observe the movement and distribution of critical macromolecules. LifeSense can also pick up the signatures of nontreated cells and tissue via native fluorescence.

VENTURES OR PRODUCT AVAILABILITY

The cardiovascular applications of Ciencia's technology are under assessment.

Oriel's LifeSense performs real-time analysis with Windows-based software on a 486 or Pentium PC and provides measurements in 1 second. The high-sensitivity, high-resolution instrument has interchangeable LED or laser light source modules and is suitable for commonly used dyes such as fluorescein, rhodamine, and phycocyanin. In addition, its compact size and light weight make it a convenient benchtop system.

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